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A SECOND NOTE ON THE GENUS *PACHYOPHTHALMUS* B. & B. (DIPTERA, TACHINIDAE)

By O. W. Richards, M.A., D.Sc., F.R.E.S.

In a recent paper (Richards, 1935), I described a new subspecies of the genus *Pachyophthalmus* which had been bred from various wasps' nests in Trinidad. Recently, owing to the kindness of Dr. F. W. Edwards, I have been able to study some more unidentified material of the genus preserved in the collection of the British Museum. Amongst this material is a long series of what appears to be a new species.

Pachyophthalmus pridei sp. n.

In my key to the genus (*loc. cit.*, : 209) it runs down to *P. erythrura* (van der Wulp) or *P. floridensis* Townsend, but differs in the male genitalia. In Allen's key (1926 : 9) it runs down to *P. floridensis*.

♂. Agrees in all particulars with Allen's description of *P. floridensis* (*loc. cit.*, : 10) but front a little narrower, frontal vitta rather less than half the width of parafrontals; a row of 5–7 bristles a little shorter than the frontals and situated just lateral to them; acrostichals all very short except the prescutellar pair; fore tibiae with a posterior bristle and two anterodorsal ones (upper one short) near mid point; narrow apex to fourth tergite reddened; fifth tergite reddish-yellow. Genitalia as in the accompanying figure.

♀. Similar, apart from slightly smaller pulvilli and genitalia; front hardly narrower; fourth tergite with no reddish margin.

In both sexes the general colour is light grey; length 4–6 mm.

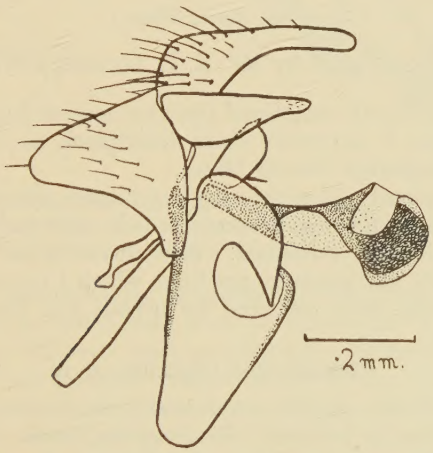


Fig. 1.—♂ genitalia of *Pachyophthalmus pridei* sp. n., seen from the left side.

Type ♂, allotype ♀, and 4 ♂♂, 5 ♀♀, 2 sex-doubtful paratypes, Paraguay : Chaco, from nest of *Trypoxylon*, i.27 (*A. Pride*), Brit. Mus. 1927–388.

Differs from *P. floridensis antillarum* Richards in its grey not brownish colour; from that subspecies as well as from typical *floridensis* in having the paralobes of the male genitalia shorter, less narrowed distally, less broadened proximally; distal part of phallus larger, process above dorsal emargination broader, spine-like projections of surface smaller and denser.

From *P. erythrura* it differs in the longer mesolobes, the shorter and broader paralobes; distal part of phallus larger, dorsal emargination wider, spine-like projections of surface shorter and denser.

A single female in the British Museum collection belongs to another species. It is impossible to be certain of the identification of isolated examples of this sex, but it appears to be the same as *P. sarcophagina* (van der Wulp) which is probably the female of *P. erythrura*; it is a light grey specimen, so it cannot belong to *antillarum*. The data are Porto Rico, from cell of *Eumenes ornatus* stored with Lepidopterous larvae, emerged 3.xii.26 (*H. E. Box*).

Finally, it may be noted that Séguy (1931) described a *Pachyophthalmus aurifacies* bred from either *Sceliphron* or *Trypoxylon* in Venezuela. I think it likely from the description and figure of the male genitalia that this is an earlier name for my subspecies *antillarum*.

References.

Allen, H. W., 1926, North American species of two-winged flies belonging to the tribe Miltogrammini. *Proc. U.S. nat. Mus.*, **68** (9) : 1–106, 5 pls.

Richards, O. W., 1935, A note on the genus *Pachyophthalmus*, B. & B. (Dipt., Tachinidae, Miltogramminae). *Stylops*, **4** : 209–213, 2 figs.

Séguy, E., 1931, Étude sur un nouveau type de Diptère parasite *Pachyophthalmus aurifacies* n. sp. *Z. Parasitenkunde*, **3** : 780–785, 2 figs.

NEW SPECIES OF COCCIDAE (HEMIPT. HOMOPT.) FROM MAURITIUS

By R. Mamet.

(*Dip. Agric. Maur.*)

Communicated by Mr. E. E. Green, F.R.E.S.

Mr. E. E. Green has kindly examined the new species described here, and it is at his suggestion that I undertake their description as a contribution to the knowledge of the Mascarene Coccid fauna.

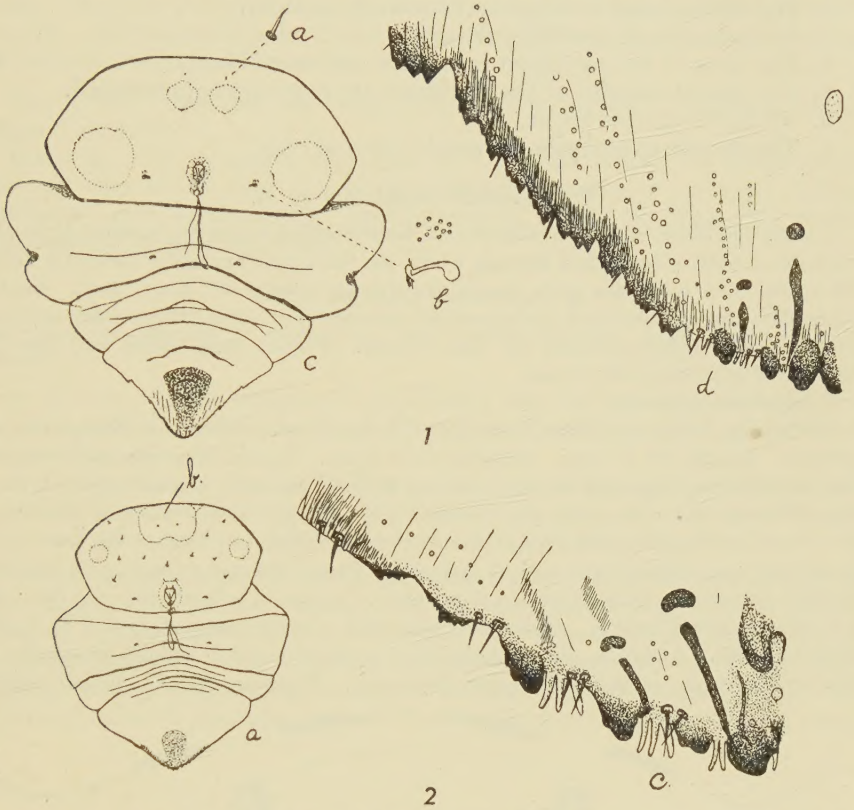
I take this opportunity of expressing my sincere thanks to Mr. Green not only for the readiness with which he examined the material but also for valuable assistance received on many occasions. In addition he has been kind enough to read through the MSS. and make suggestions which I have adopted.

All the new species were collected by myself and the types and cotypes are in my collection.

Pseudaonidia tripartita sp. n.

♀ *puparium* : dark brown, slightly convex, oval to circular, covered by the outer layers of host-plant stem. Exuviae brownish. First exuviae darker. Diameter of puparium 2–2·5 mm. Ventral scale represented as a whitish scar on the surface of the bark of the host-plant. *Adult* ♀ broadly turbinate (fig. 1 c), wine-red in colour, with the pygidium brownish. Length, 2 mm. Breadth, 1·5–2·0 mm. Derm almost uniformly sclerous, with four roundish clearer areas one on each side of the rostrum and a more or less confluent pair on the frontal area. Cephalothorax separated from the abdomen by a deep and broad V-shaped incision. Mouth-parts comparatively narrow and small. Antennal tubercle (fig. 1 a) with one slightly curved bristle. Anterior spiracle (fig. 1 b) with a compact group of 9–11 small parastigmatic pores. Meso- and metathoracic segments markedly separated from the cephalothorax and abdomen respectively, thus dividing the insect into three dis-

tinct parts (fig. 1 c). Abdominal segments fused. *Pygidium* (fig. 1 d) rather bluntly pointed as compared with *P. clavigera* Ckll., with three pairs of well chitinised and externally notched trullae all approximately of the same conical form. Median pair largest and most conspicuous, and, in addition, slightly notched internally; second pair closely adjacent to



FIGS. 1–2.—(1) *Pseudaonidia tripartita* sp. n.; a. antennal tubercle; b, anterior spiracle with parastigmatic glands; c, adult ♀; d, margin of pygidium. (2) *Pseudaonidia lacinioides* sp. n.; a, adult ♀; b, translucent area on frons; c, margin of pygidium.

the median, smallest; third pair widely separated from the others by an interval of about twice their own breadth and about equal in size to second pair. The trullae are succeeded by a series of marginal prominences which are difficult to distinguish from the actual trullae. These prominences become gradually reduced in size as they approach the base of the pygidium. Squamae short and inconspicuous. Spines short and stout. Perivulvar pores in five groups, the three upper groups confluent forming a continuous arc containing from 50–78 pores, lower groups each with from 11 to 17. Numerous small circular dorsal pores arranged in definite longitudinal series on each lateral surface of pygidium. Lateral margin of pygidium strongly serrated. Two pairs of conspicuous claviform paraphyses present, each furnished with a separate circular to subcircular knob; the median pair largest. A large reticulated area with constant boundaries and oval or round lacunae present on the dorsal surface of the pygidium. Vulva situated high up between the two posterior groups of perivulvar pores. Anal orifice more or less ovoid placed a little below midway between the apex of the pygidium and the vulva.

♂ unknown.

Mauritius: Rose Hill, on Camellia twigs. Collected by the author, 29.vii.1933.

Remarks.—This insect is very closely related to *P. clavigera* Ckll., but differs from it by the following characteristics :—

1. The whole insect is larger and relatively broader.
2. Its form is more markedly tripartite.
3. The apex of the pygidium is broader and more blunt.
4. The lateral margins of the pygidium are more strongly serrated.
5. All the trullae are larger.
6. The clavate paraphyses are nearly twice as long.

Pseudaonidia lacinioides sp. n.

♀ *puparium* black, circular to subcircular, hemispherical to conical, completely covered by tissues of bark of host-plant through which the black first exuviae is distinctly visible. When seen from below the scale is capsular with its inner walls shiny black. Exuviae subcircular; first exuviae black and sometimes surrounded by a ring of dirty white secretion, second exuviae black obscured by bark tissues. Ventral scale white and film-like. Diameter of puparium, 1·0–1·5 mm.

♂ *puparium* unknown.

Adult ♀ (fig. 2 a) general form : turbinate; bordeaux-red in colour, containing numerous embryos. Length, 1·2–1·7 mm. Breadth, 1·2–1·5 mm. *Cephalothorax* markedly narrower than the following segments, broadly rounded in front, the sides sloping slightly inwards. Cephalothorax with a few small and scattered setae, sharply divided from the mesothorax by a transverse furrow, with a large sharply defined translucent area on the frons and a smaller and more diffused pale area on each side. Derm rigid and sclerose, with a delicate wrinkled pattern resembling that of a finger print. Antennal tubercle with one stout long and slightly curved bristle. Anterior spiracle with a small group of from 3 to 4 parastigmatic pores. Abdomen short. Abdominal segments not well defined marginally but transverse divisions of segments sharply demarked. Pygidium (fig. 2 c) broadly obtuse.

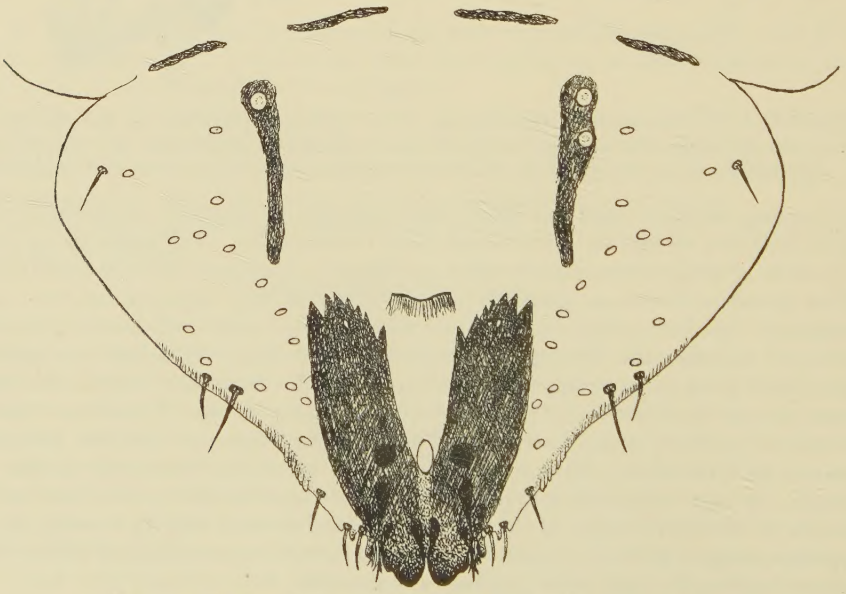


Fig. 3.—*Chrysomphalus alluaudi* sp. n.; pygidium of adult ♀.

Four pairs of externally notched trullae. Apex of median trullae usually flatly rounded; first lateral trullae smallest. The two others subequal in size. Beyond these are two equally spaced dentate prominences. Perivulvar pores absent. Squames narrow, hyaline. Spines stout, as long as squames. Anal orifice guarded on each side by a tongue-shaped process. Two pairs of divergent paraphyses each with an isolated knob beyond the inner extremity; medium pair longest. Dorsal surface of pygidium with a large reticulated area with the lacunae small, circular or oval.

MAURITIUS: Rose Hill, on twigs of *Tamarindus indicus*. Collected by the author, 7.xii.1933.

Remarks.—This species is very near to *P. laciniae* Brain. It differs in the relatively shorter abdomen and in the constant presence of a sharply defined translucent area on the frons. In this respect, but in no other, the species approaches *P. glandulosa* Newst.

Chrysomphalus alluaudi sp. n.

♀ *puparium* irregular in outline but more or less circular. Exuviae subcentral to eccentric.

On *Rosa* sp.—Female puparium straw-coloured with the first exuviae fulvous; the second brownish-yellow and obscured by a layer of creamy secretion. Ventral scale white and thin.

On *Spondias dulcis.*—Female puparium completely covered by epidermal layer of cells of host-plant with the exception of the first exuvia which shows faintly and which is dark fulvous brown. Insect difficult to remove from its puparium.

Adult ♀ yellowish, pyriform with the abdominal segments somewhat retracted into the body. Length, 1·4–1·6 mm. Breadth, 0·9–1·0 mm. *Cephalothorax* broadly rounded. Antennal tubercle with one slightly curved bristle. Parastigmatic glands absent. Pygidium (fig. 3) sharply pointed. Only one pair of large, prominent, externally notched and closely adjacent trullae present, forming the apex of the sharply pointed pygidium, their bases extending far into the pygidium. Other trullae obsolete, each being represented by a small

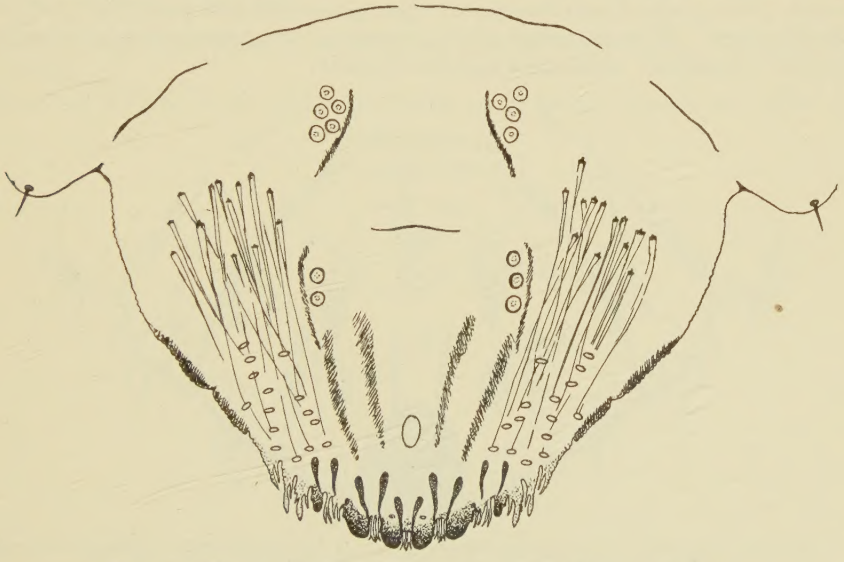


FIG. 4.—*Chrysomphalus castigatus* sp. n.; pygidium of adult ♀.

hyaline projection on the lateral margin of the pygidium. Perivulvar pores in two groups, each group bearing 0 to 2 openings. Two very slender squames with deeply incised extremities present shortly exterior to the median trullae. Spines long and stout. A pair of elongate capitate paraphyses and three pairs of shorter paraphyses of the ordinary form present. Dorsal pores few on each lateral surface of pygidium.

Mauritius : on *Rosa* sp., Reduit, i.1934; and *Spondias dulcis*, Rose Hill, 4.i.1934. Collected by the author.

Chrysomphalus castigatus sp. n.

♀ *puparium* oval to circular : median area conical. Colour yellowish-buff, semi-transparent, more or less showing the form of the insect beneath it. Exuviae subcentral. First exuviae surmounted by a central dot, reddish-buff, surrounded by a concentric ring of whitish secretion; second exuviae a little darker than the rest of the puparium and often obscured by a thin layer of whitish secretion. Ventral scale very thin and nearly colourless. Texture of puparium fragile and soft. In dried examples the concentric " ring and dot " effect is most remarkable and the exuviae are darker than the rest of the puparium. Ventral scale very thin and whitish.

♂ *puparium* not found.

Adult ♀ yellowish, very soft, difficult to remove from puparium, pyriform, viviparous. *Cephalothorax* relatively broad with margin rounded. Antennal tubercle with one long and slightly curved bristle. Parastigmatic glands absent. Abdominal segments more or less retracted into the body. Marginal areas of retracted segments with 3–4 glandular openings. *Pygidium* (fig. 4) with three pairs of well-defined and externally notched trullae. Median largest and indented on both margins. 1st lateral a little smaller than median and 2nd lateral than 1st lateral. Squames deeply fringed and placed as follows : two between the median trullae and equal to them in length, two in each first lateral space, three in the second lateral space, of which the first two are linear and simple, and the third longer and markedly bifid. Finally beyond the last trulla, on each side, are three conspicuous squames which are markedly broader than the others and deeply fimbriate on their sloping outer margins. Lateral margin of pygidium finely cristate. Five pairs of elongate clavate paraphyses present. Four groups of perivulvar pores; upper groups with from 4 to 6 and lower groups with from 2 to 3. *Spines* very short and inconspicuous. Oval dorsal pores in two series on each side of pygidium. Anal orifice near the extremity.

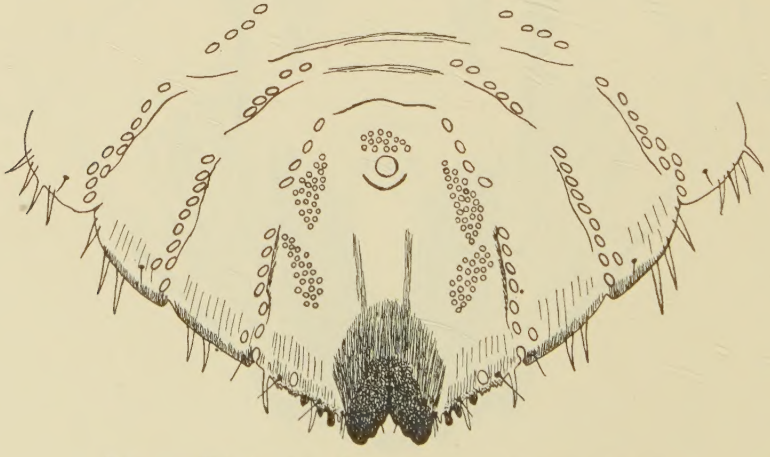


Fig. 5.—*Chionaspis cordiae* sp. n.; pygidium of adult ♀.

Mauritius: Rose Hill, 29.vii.1933; and Ebène, 18.iii.1934, on leaves of *Furcraea gigantea*, in association with *Chrysomphalus ficus* Mask., *Pinnaspis minor* Mask. and *Lecanium mauritiense* sp. n. Collected by the author.

(The specific name is suggested by the habit of the insect which was found on both occasions in hidden places, particularly on the very basal leaves of the host-plant.) The scales are sometimes massed together in large numbers so as to cover large patches on the leaves.

Chionaspis cordiae sp. n.

♀ *puparium* white, fulvous white in specimens obscured by layers of bark tissue. Elongate, moderately dilated behind. Posterior margin more or less depressed or flattened. First exuviae shiny, golden yellow and more or less transparent. Second exuviae reddish to brownish-yellow covered by a thin layer of white secretion. Length, 2·25–2·75 mm. Breadth, 0·75–1·00 mm.

♂ *puparium* unknown.

Adult ♀ pale yellow with darker pygidium. Pygidium spotted with white secretion. Length, 1·5–2·0 mm. Mounted ♀ elongate; broadest across the abdominal segments. Antennal tubercle bearing one longish stout bristle and a pair of short spines. Anterior spiracle with a close series of 4 or 5 largish colourless pores which are very difficult to distinguish. Lateral areas of meso-metathoracic and abdominal segments with few small oval dorsal pores. Abdominal segments slightly produced. Segments prior to pygidium with a group of 4–5 spiniform squames on each lateral marginal surface. *Pygidium* (fig. 5) rather pointed with three pairs of trullae; the median ones which alone are very conspicuous divergent, prominent and well chitinised with the inner margin notched once and the outer one very faintly serrated; second pair duplex; inner lobule larger and rounded at its apex, outer one smaller; third pair conical. Perivulvar pores in five groups, the mesal group with from 13 to 15, upper laterals with from 19 to 27 and lower laterals with from 24 to 27. Dorsal pores large and conspicuous. Squames long and spiniform. Spines in pairs one on each surface of pygidium, ventral ones shorter but stouter. *Eggs* pale yellow to reddish fulvous. Found in great numbers in the waxy secretion beneath the puparium. Newly hatched larva orange-yellow.

Mauritius: Rose Hill, 21.v.1933, on stems of *Cordia myxa*. Collected by the author.

Remarks.—This insect is closely related to *C. manni* Green, but differs in

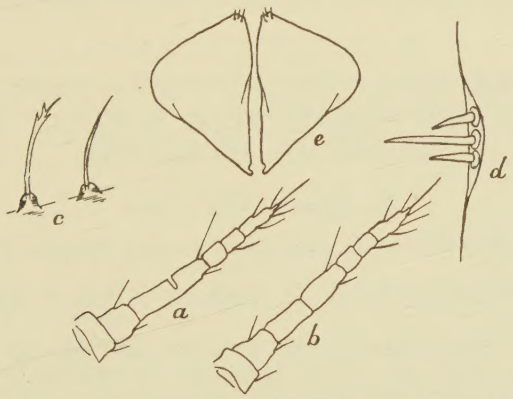


Fig. 6.—*Lecanium mauritiense* sp. n.; a, 6-jointed antenna; b, 7-jointed antenna; c, marginal spines; d, stigmatic spines; e, plates of anal operculum.

its more elongate form and in having fewer dorsal pores on the margin of the abdomen.

It is parasitised to some extent by a small, undetermined, hymenopteron.

Lecanium mauritiense sp. n.

Adult ♀ broadly ovate, narrower in front, broadly rounded behind, moderately convex above. Colour, in young adult ♀, yellowish-brown with a dark brown median fascia consisting of irregular dotted patches. In old ♀♀ the colour is deep brown with a median blackish fascia. Malphigian tubes in young adult ♀♀ more or less showing through the derm as a looped chain of brown spots. Living insect shiny and smooth. Margin thin and semi-transparent. Anal valves brown with darker margin. Under surface of old examples concave with a deep purple abdominal patch. Mouth-parts relatively small. Eyes black, submarginal, situated in the semi-transparent area of the margin. Stigmatic cleft with three stout and pointed spines projecting beyond the margin (fig. 6 d): the median one about twice the length of the other two which are equal in length. Marginal spines (fig. 6 c) curved and slender, of two types: simple or with obscurely fimbriate extremity. No submarginal tubercles. Plates of anal operculum (fig. 6 e) triangular; inner edge longest, outer edge slightly convex and nearly equal in length to base, the latter straight; outer angle obtuse, apex slightly truncate bearing 3 short hairs. Anal ring with 6 hairs. Anal sac very conspicuous. Anal cleft approximately one-fifth of total length of the body. Derm with small oval or round pores narrowly surrounded by a slightly darker zone particularly on the posterior extremity, in addition it exhibits a tessellated pattern of large and crowded hyaline cells, more particularly noticeable on the submarginal areas. Antenna of 7 segments (fig. 6 b); average formula: 4, 3, 7, 2, 1, (6, 5). In one example only, antenna 6-segmented (fig. 6 a); formula: 3, 6, 2, (1, 4) 5. Legs rather short: coxa thick and equal in length to tibia; femora longer than tibia, tarsus shorter than tibia with four digitules; the tarsals in the form of knobbed hairs and the unguals stout and spatulate about twice length of claw. Length, 2·5–3·5 mm. Breadth, 2–3 mm.

The insect is ovo-viviparous.

Young larva minute, very pale pinkish.

♂ unknown in any stage.

Mauritius: Rose Hill, 29.vii.1933; and Ebène, 18.iii.1934, on leaves of *Furcraea gigantea*. Collected by the author.

Attended by the black ant *Technomyrmex albipes* Smith, and parasitised to some extent by a small black undetermined hymenopteron.

APHIDS OF THE GENUS *ASTEGOPTERYX* KARSCH, WITH DESCRIPTIONS OF NEW SPECIES FROM SUMATRA AND FORMOSA (APHIDIDAE, HEMIPTERA)

By Ryoichi Takahashi.

(*Department of Agriculture, Government Research Institute, Formosa.*)

Communicated by Dr. S. A Neave, O.B.E., F.R.E.S.

The species of *Astegopteryx* Karsch produce galls on the trees of *Styrax* (Styraceae). The trees are widely distributed in the world, but the aphids are found only in Oriental countries, and at present 15 species are known, which are distinguished as follows:—

Winged viviparous ♀.

1. The 4th antennal segment usually wanting secondary sensoria, but sometimes with a secondary one, the 5th always wanting them . . . . . 2.
   The 4th antennal segment with some secondary sensoria, the 5th with or without . . . . . 6.
2. The 3rd antennal segment nearly as long as, or longer than, the 4th and 5th together, with 10–22 sensoria . . . . . 3.
   The 3rd antennal segment shorter than the 4th and 5th together, with 1–15 or no sensoria; front ocellus nearly as large as the dorsal ones, on a large protuberance; head with about 14 dorsal setae, which are absent between the dorsal ocelli; abdomen scarcely, or not, thickened on the 8th tergite; cornicles surrounded with about 9 or 10 setae; cauda with about 20 setae; front and middle tarsi with 2 stout median setae and 2 longer lateral setae on the basal segment, hind tarsi with a median seta and 2 longer lateral setae on the basal segment; on *S. suberifolium* in Formosa . . . . . *A. jamuritsu* Takahashi.
3. The 3rd antennal segment nearly as long as the 4th and 5th together; front and middle tarsi with 4 setae on the basal segment, of which the median 2 are much shorter . . . . . 4.
   The 3rd antennal segment distinctly longer than the 4th and 5th together; front and middle tarsi with 4 setae subequal in length on the basal segment; cornicles surrounded with about 9 short setae; on *S. subdenticulatus* and *S. serrulatus* var. *mollissimus* in Sumatra *A. sumatrana* Lambers.
4. The 4th antennal segment distinctly shorter than the 5th . . . . . 5.
   The 4th and 5th antennal segments nearly equal in length; on *S. benzoin* in Sumatra . . . . . *A. lambersi* sp. n.
5. Primary sensoria on the antennae wider than the secondary ones; hind tarsi with 4 setae on the basal segment, of which the median 2 are shorter; abdomen slightly thickened or sclerotised on the 8th tergite; cauda nearly conical; on *S. formosanum* in Formosa . . *A. taiwana* Takahashi.
   Primary sensoria on the antennae not wider than the secondary ones; hind tarsi with 3 or 4 setae on the basal segment; abdomen not sclerotised on the dorsum; the 3rd antennal segment sometimes slightly shorter than the 4th and 5th together; on *S. subdenticulatus* and *S. serrulatus* var. *mollissimus* in Sumatra . . . . . *A. vandermeermohri* Lambers.
6. The 3rd antennal segment much longer than the 4th and 5th together . . 7.
   The 3rd antennal segment nearly as long as, or shorter than, the 4th and 5th together . . . . . 9.
7. The 5th antennal segment with 0–4 secondary sensoria . . . . . 8.
   The 5th antennal segment with 5–8 secondary sensoria, the primary sensorium small; head with about 22 short dorsal setae; front ocellus much smaller than the dorsal ones, on a small protuberance; cornicles small, surrounded with about 3 or 4 setae; the 8th abdominal tergite very slightly, or scarcely, thickened; cauda with about 15 setae; front and middle tarsi with 2 stout median setae and 2 much longer lateral setae on the basal segment, but hind tarsi with only 2 long setae on the basal segment; on *S. suberifolium* in Formosa . *A. styracicola* Takahashi.
8. The 3rd antennal segment very stout, stouter than the 4th, with 30–39 sensoria; the 4th shorter than the 5th; the 5th with a narrow primary sensorium; head with a pair of short spine-like setae on the front; on *S. serrulatus* var. *mollissimus* in Sumatra . . . . . *A. leeuweni* sp. n.
   The 3rd antennal segment not stouter than the 4th, with 15–23 sensoria; the 4th nearly as long as the 5th, the 5th with a wide primary sensorium; on *S. benzoin* in Java . . . . . *A. fransseni* Lambers.

9. The 5th antennal segment with 3–16 secondary sensoria . . . . . 10.
   The 5th antennal segment without secondary sensoria; abdomen very slightly thickened on the 8th tergite; on *Styrax* sp. in Japan *A. takenouchii* Takahashi.
10. Posterior abdominal tergites with sclerotised or thickened areas . . . . 11.
    Posterior abdominal tergites not thickened or sclerotised . . . . . 13.
11. The 8th abdominal tergite sclerotised at the bases of setae; on *S. parallelneurus* in Sumatra . . . . . *A. roepkei* Lambers.
    The 6th–8th abdominal tergites thickened or sclerotised . . . . . 12.
12. Front ocellus on a small protuberance; cornicles not surrounded with setae; on *S. japonicus* in Japan and on *Styrax* spp. in Corea, Formosa and Amamioshima (Loochoo) . . . . . *A. nekoashi* Sasaki.
    Front ocellus on an eminent protuberance; cornicles surrounded with about 3–5 setae; on *S. suberifolium* in Formosa . . . *A. swinhoei* sp. n.
13. Head with some small irregular paler areas on the median part of dorsum; on *S. suberifolium* in Formosa . . . . . *A. sasakii* sp. n.
    Head without paler areas on the dorsum . . . . . 14.
14. Mouth-parts with some distinct rounded granules; front tibiae nearly as long as the distal 3 antennal segments together; the 3rd antennal segment as long as the 4th and 5th together, the 4th as long as the 5th, the distal part of the 5th short, nearly as long as wide; on *S. benzoin* in Java and Sumatra . . . . . *A. styracophila* Karsch.
    Mouth-parts without distinct granules; front tibiae much shorter than the distal 3 antennal segments together; the 3rd antennal segment a little shorter than the 4th and 5th, the 4th somewhat shorter than the 5th, the distal part of the 5th distinctly longer than wide; on *S. obassia* in Japan *A. styraci* Matsumura.

Astegopteryx lambersi sp. n.

Winged viviparous ♀. Head without paler areas on the dorsum, with about 16–20 dorsal setae, which are absent between the dorsal ocelli, and with some pairs of rather long setae on the front, which converge, nearly reaching the apex of front ocellus. Front ocellus nearly as large in diameter as the dorsal ones, on a large protuberance. Antennae slender, rather long; the 3rd segment with 4 rather long stout setae on the distal half and 12–15 sensoria; the 4th somewhat narrowed towards the base, not constricted basally, lacking secondary sensoria, with 2 or 3 setae; the 5th somewhat narrowed towards the base, without secondary sensoria, with a seta at the middle of the basal part; primary sensoria on the 4th and 5th small, but distinct, a little wider than the secondary ones on the 3rd, transversely narrowed; the relative length of segments about as follows: III—55, IV—25, V—26. Mouth-parts with some indistinct shallow granules, rostrum reaching a little beyond the front margin of mesosternum. Abdominal tergites not sclerotised. Cornicles rather large, surrounded with about 5 setae. Cauda much wider than long, not constricted basally, rounded at the apex, much larger than the anal lobes, with about 16–20 long bristles. Anal plate divided, with about 6 setae on each lobe. The 1st and 2nd obliques on the front wings stout, united basally, a little stouter than the 3rd; the 3rd obsolete on the basal part, once branched; hind-wings with normal veins and 2 hooklets. Trochanters not defined; femora narrowed on the basal part, with some long setae; tibiae as stout as, or stouter than, the 3rd antennal segment, with many rather long, stiff, stout, setae; tarsi somewhat striate, with a pair of very long rather stout, capitate, setae at the apex; front and middle tarsi with 2 median stiff setae and 2 longer fine setae on the basal segment, the latter about 1·5 times as long as the former; hind tarsi nearly as long as the last antennal segment, with a median stiff seta and 2 much longer fine setae on the basal segment; empodial setae capitate, longer than the claws. Length of body, about 1·75 mm.; head including front ocellus, about 0·231 mm.; antenna,

about 0·61 mm.; hind tibia, about 0·586 mm.; width of head including eyes, about 0·44 mm.; diameter of cornicle, about 0·037 mm.; width of cauda, about 0·106 mm.

Host-plant.—*Styrax benzoin.*

Sumatra: Brastagi; many winged and wingless ♀♀ (*Prof. J. C. van der Meer Mohr*), 17.ii.1935. The wingless form possesses a pair of curved spines on the front, which are much shorter than the 1st antennal segment, and the antennae rather long and 5-segmented, the 3rd segment being longest. The dried gall is dark brown, hard, as in the figure in shape, about 27 mm. long, with a large cell within and a large circular opening on the distal side.

Fig. 1.—Gall of *Astegopteryx lambersi* sp. n.

Allied to *A. vandermeermohri* Lambers, but differs in the antennae being longer and more slender, the 4th antennal segment nearly as long as the 5th, the cornicles larger, and the lateral setae on the basal segment of front tarsi shorter.

Named after Dr. Hille Ris Lambers, who has described some interesting members of the genus from the Dutch East Indies.

Astegopteryx leeuweni sp. n.

Winged viviparous ♀. Head paler on the postero-lateral areas adjacent to the eyes, with a pair of short pointed spine-like setae on the front above the front ocellus, and about 15 short dorsal setae, which are mostly present on the anterior part and absent between the dorsal ocelli; the spine-like setae much shorter than the 1st antennal segment. Front ocellus as large as, or a little smaller than, the dorsal ones in diameter, moderately protruding. Antennae stout; the 3rd segment very stout, much stouter than the tibiae, about 6 or 7 times as long as wide, usually slightly curved, constricted at the base, not narrowed apically, with about 5 short setae, and 30–39 narrow sensoria irregularly and densely arranged over the whole length except on the basal small part, the sensoria divided to several parts, occupying nearly the whole of the circumference of the segment; the 4th distinctly narrower than the 3rd, slightly or distinctly narrowed towards the base, about twice as long as wide, with 2 or 3 short setae, and 3–6 secondary sensoria, which occupy over half the circumference of the segment and are rarely absent, the primary sensorium narrow, but rarely very wide, sometimes absent; the 5th usually not constricted basally, with a seta on the basal part, some apical setae, 0–2 secondary sensoria, and a narrow primary sensorium; the relative length of segments about as follows:

III—60, IV—15, V—20. Mouth-parts with a few rounded granules on the anterior part, rostrum not reaching the middle coxae. Abdomen not sclerotised on the dorsum, with many rather short transverse rows of minute spinules on the posterior part of dorsum. Cornicles small, not on sclerotised areas, surrounded with about 3 setae. Cauda rounded, not constricted basally, with 11 or 12 setae. Anal plate divided, the lobes rounded, much wider than long, a little narrower than the cauda, not constricted basally, with 6–9 setae. Front wings imbricated, with stout veins; the 1st oblique a little curved distally, a little stouter than the 3rd, united basally with the 2nd; the 3rd obsolete on the basal part, once branched; hind-wings with normal veins and 2 long hooklets. Trochanters not defined; tibiae with some rows of spinules on the distal part and many setae, front tibiae shorter than the distal 3 antennal segments together; tarsi with many rows of distinct spinules, front and middle tarsi with 2 median setae and 2 longer lateral setae on the basal segment, the latter nearly twice as long as the former; hind tarsi nearly as long as the 5th antennal segment, with a median and 2, much longer, lateral setae on the basal segment; empodial setae capitate, shorter than the distal capitate setae of tarsi. Length of body, about 1·6 mm.; head including front ocellus, about 0·21 mm.; antenna, about 0·52 mm.; hind tibia, about 0·46 mm.; width of head including eyes, about 0·38 mm.; diameter of cornicle, about 0·018 mm.; width of cauda, about 0·092 mm.

Host-plant.—*Styrax serrulatus* var. *mollissimus*.

Sumatra: Lau Deboek Deboek; some adults and nymphs (*Prof. J. C. van der Meer Mohr*), vi.1935. Closely allied to *A. fransseni* Lambers, differing, however, in the antennae being stouter, the 3rd segment very stout, with more sensoria, the 5th longer than the 4th, with a narrow primary sensorium, and the cornicles surrounded with fewer setae. This species is peculiar in that the adult ♀ has a pair of spine-like setae on the front as in the nymph. The gall is slender, and has been described and figured by Prof. Docters van Leeuwen from Sibolangit, Sumatra (1926, *Zoocecidia of the Netherlands East Indies* : 458, fig. 874). Named in honour of Prof. Docters van Leeuwen, who has contributed much to the knowledge of the galls on *Styrax*.

Astegopteryx swinhoei sp. n.

Astegopteryx nekoashi Takahashi (*nec* Sasaki), 1929, *Trans. nat. Hist. Soc. Formosa*, **19** : 530.

Winged viviparous ♀. Head broadly rounded on the hind margin, without paler areas on the dorsum, with about 40 rather short dorsal setae, which are absent on the posterior marginal area. Front ocellus nearly as large as, or a little smaller than, the dorsal ones, on an eminent protuberance. Antennae long; the 3rd segment straight or slightly curved, with 27 sensoria; the 4th a little narrowed at the base, with 15 sensoria; the 5th also a little narrowed at the base, with 8–11 sensoria; the relative length of segments about as follows: III—85, IV—41, V—42. Rostrum reaching beyond the front coxae. Abdomen distinctly thickened and dusky on the 7th and 8th tergites and around the bases of setae on the 6th tergite. Cornicles small, surrounded with 3–5 setae. Cauda broadly rounded on the hind margin, not constricted basally, much wider than long, with about 18 long bristles. Anal plate divided, the lobes as wide as the cauda, with about 11 long bristles. Wing-vein stout, normal; the 1st and 2nd obliques on the front wings a little curved, united basally, the 3rd nearly as stout as the 2nd, but a little paler. Legs slender, with many setae; trochanters not defined; front tibiae nearly as stout as the antennae; tarsi a little imbricated, the distal long setae thin, not capitate, front and middle tarsi with 2 long, stiff, median, and 2 much longer, lateral, setae on the basal segment, hind tarsi with 2 very long setae on the basal segment; empodial setae thin, slightly capitate. Length of body, about 2·0 mm.; head including front ocellus, about 0·28 mm.; antenna, about 0·88 mm.; hind tibia, about 0·95 mm.; hind tarsus, about 0·125 mm.; front wing,

about 3·0 mm.; width of head including eyes, about 0·45 mm.; diameter of cornicle including margin, about 0·036 mm.; width of cauda, about 0·106 mm.

Host-plant.—*Styrax suberifolium.*

Formosa: Taihoku; described from specimens taken by myself, 6.viii.1927. The nymph has 2 pairs of short spines on the front, which are longer in the young instars. The 1st instar has the front femora stouter than other femora, the antennae 5-segmented, and the setae on the basal tarsal segments similar to those of the adult. The gall is similar to that of *A. styracophila* Karsch, easily distinguished from it, however, by the posterior abdominal tergites thickened. Named in memory of the late Robert Swinhoe, the first British consul at Formosa and pioneer of the zoology of that island.

Astegopteryx sasakii sp. n.

Astegopteryx styracophila Takahashi (*nec* Karsch), Aphididae of Formosa, II. 1923, *Rept. Dept. Agric. Govt. Res. Inst. Formosa*, **4** : 54; 1931, VI. *Ibid.* **53** : 86 (in part); 1934, *Mushi*, **7** : 73 (in part).

Winged viviparous ♀. Head with some distinct small irregular paler areas on the median part of dorsum, and about 30 short dorsal setae. Antennae much stouter than the tibiae; the 4th segment slightly shorter than the 5th. Front ocellus smaller than the dorsal ones, on a somewhat protruding part. Abdomen not, or scarcely, thickened on the 8th tergite. Cornicles surrounded with 5 or 6 long setae. Cauda much wider than the anal lobes, broadly rounded on the hind margin. Tarsi imbricated, with the distal long setae and empodial setae capitate; front tarsi with 2 median and 2 longer lateral setae on the basal segment, middle tarsi with a median, and 2 much longer lateral, setae on the basal segment, hind tarsi with only 2 very long setae on the basal segment. Other characters are given in an earlier description (1923).

Host-plant.—*Styrax suberifolium.*

Formosa: Taihoku, Sozan, Kannonzan, Dandan near Kiirun, Suisha; very common.

The gall is similar to that of *A. styracophila* Karsch, to which it is very closely allied, and was formerly recorded as that species, but differs in the head possessing irregular paler areas on the median part of dorsum, the antennae being shorter and stouter, the 4th antennal segment slightly shorter than the 5th, the legs shorter, and the setae on the basal segments of middle and hind tarsi different in number. Named in honour of Prof. C. Sasaki, who has contributed much to the study of *A. nekoashi* Sasaki.

The paler areas on the head and the sclerotised parts of abdominal tergites in Aphids of this genus are discernible in specimens treated with potash.

Astegopteryx nekoashi Sasaki.

1911. *Ier Congr. int. Ent. Bruxelles* 1910, **2** : 449; Takahashi, 1923, Aphididae of Formosa, II, *Rept. Dept. Agric. Govt. Res. Inst. Formosa*, **4** : 146.

Winged viviparous ♀. Head broadly rounded on the hind margin, lacking distinct paler areas on the dorsum, with about 20 short dorsal setae, which are mostly on the anterior half (especially on the median area), absent on the posterior part, and usually 4 or more of them are arranged in a transverse row behind the dorsal ocelli. Front ocellus much smaller than the dorsal ones, on a somewhat protruding part. Antennae rather long; the 2nd segment with many transverse rows of small spinules and a minute circular apical pore as in other species of the genus; the 3rd straight or slightly curved, with 24 or 25 sensoria; the 4th and 5th narrowed on the basal part, the former with 12–15 sensoria, but the latter with 9–13; sensoria not constricted or divided; the relative length of seg-

ments about as follows: III—65, IV—38, V—42. Mouth-parts with many rather large rounded granules, rostrum reaching beyond the front coxae. Abdomen with many transverse rows of minute spinules on the dorsum and venter of posterior part; the 6th–8th tergites, especially the 7th and 8th, a little sclerotised. Cornicles small, not on thickened parts, not surrounded with setae. Cauda short, very wide, broadly rounded on the hind margin, with about 13 long bristles. Anal plate bilobed, the lobes wider than long, narrower than the cauda, with about 8 or 9 bristles. Legs slender, with many setae; trochanters not defined from the femora; front tibiae as stout as or narrower than the antennae; tarsi a little imbricated, front and middle tarsi with a long median seta and 2 much longer fine lateral ones on the basal segment, hind tarsi shorter than the 4th antennal segment, with only 2 very long setae on the basal segment; each distal segment of tarsi with long distal setae usually not capitate, shorter than the knobbed empodial setae. Wing-veins normal, the 2nd oblique very slightly stouter than the 3rd. Length of body, about 1·75 mm.; head including front ocellus, about 0·24 mm.; antennae, about 0·76 mm.; hind tibia, about 0·61 mm.; hind tarsus, about 0·092 mm.; width of head including eyes, about 0·44 mm.; diameter of cornicle including margin, about 0·026 mm.

Host-plant.—*Styrax* sp.

Formosa: Bonbon, Kobayashi (Rato-Gun); described from specimens collected by myself, viii.1934. This species was formerly regarded as identical with *A. styracophila* Karsch, but differs in the posterior abdominal tergites thickened, the cornicles not surrounded with setae, etc. The galls of this species and *A. styracicola* Takah., are attacked by the larvae of *Hyphantidium* sp. (Pyralidae) in Formosa.

Astegopteryx styraci Matsumura.

1917, *Coll. Essays for Y. Nawa, Gifu, Japan* : 53.

Winged viviparous ♀. Head without paler areas on the dorsum, with about 20 short dorsal setae, which are absent on the median area. The 3rd antennal segment straight, with 12–19 sensoria except on the basal small part, and about 3–6 short setae; the 4th somewhat constricted at the base, with 5–10 secondary sensoria, of which the apical one is sometimes widened; the 5th with 3–9 secondary sensoria, the distal part distinctly longer than wide; secondary sensoria much wider than those of *A. nekoashi* Sasaki; primary sensoria on the 4th and 5th wide, distinct; the relative length of segments about as follows: III—45, IV—25, V—29. Front ocellus smaller than the dorsal ones, on a distinct protuberance. Rostrum not reaching the middle coxae. Abdominal tergites scarcely sclerotised on the posterior segments. Cornicles surrounded with 4 setae. Cauda conical, rounded apically, wider than long, with about 15 setae. Anal plate divided, the lobes rounded, with some setae. Trochanters not defined; front and middle tarsi with 2 median and 2 much longer lateral setae on the basal segment, hind tarsi a little shorter than the 5th antennal segment, somewhat imbricated, with a median and 2 much longer lateral setae on the basal segment. Length of body, about 1·45 mm.; antenna, about 0·464 mm.; hind tibia, about 0·4 mm.; width of head including eyes, about 0·35 mm.; diameter of cornicle, about 0·027 mm.

Host-plant.—*Styrax obassia.*

Japan: Iwate-Ken (*Prof. K. Monzen*), 8.ix.1929.

In preparing this paper I am much indebted to Prof. J. C. van der Meer Mohr, Dr. Hille Ris Lambers, Dr. K. Monzen, and Mr. H. Suenaga, who have kindly sent me many specimens of the aphids and the galls.

The type specimens are in the collection of the Department of Agriculture, Government Research Institute, Formosa.

THE SUBFAMILIES OF TETTIGONIIDAE (ORTHOPTERA)

By Friedrich E. Zeuner, London.

Communicated by A. W. McKenny Hughes, F.R.E.S.

In a paper on the fossil and Recent Prophalangopsidae (1935) I have sketched the outlines of a new classification of Saltatoria. This classification was based on a study of the phylogenetic evolution of the wings, on the structure of the head, the thorax, and other morphological characters. Full details will be found in my catalogue of the Fossil Saltatoria now in preparation.

In another recent paper I have described the tracheal apparatus of the prothorax of Saltatoria (1936). In the non-Acridioid groups, this apparatus was subject to considerable specialisation in the course of its phylogenetic evolution. Fortunately, many Recent forms have retained primitive evolutionary stages of the tracheal apparatus, mostly in combination with other original characters. It is therefore possible to base a classification on the form of the prothoracic tracheal tract. The new arrangement given here concerns the families, and, especially, the subfamilies of Tettigoniidae, and it agrees well with the results of palaeontological investigations. It is, however, impossible to arrange Recent forms, or groups, in a perfect phylogenetic line, and any linear arrangement in classification is necessarily a compromise.

The differences in the tracheal tract of the prothorax also may be successfully used to distinguish allied genera.

A description of the tracheal tracts will be found in the paper already referred to (1936). To summarise briefly, there are two prothoracic stigmata on either side of the body in Tettigoniidae. The upper, or frontal, one provides for the organs of the body; the lower, or distal, one which is mostly very large, leads into a wide bag ("vesicula femoralis"), and thence into the "femoral trachea" which is connected with the auditory apparatus in the fore leg.

Gryllacrididae. In Gryllacrididae no such specialisation is found. There is only one stigma from which several tracheal stems originate. A branch of the lowermost main stem enters the fore leg. This is by far the most primitive arrangement. In spite of certain deviating adaptations the Gryllacrididae must therefore be considered as the most primitive living family of Saltatoria.

Prophalangopsidae. In this family, "double stigmata" are found, with a lower compartment being the entrance to a separated femoral tract. A vesicula femoralis is already differentiated and, in the genus examined, *Cyphoderris*, it is similar to that of primitive Tettigoniidae. This agrees closely with other facts which show that the Recent genus *Cyphoderris* more nearly approaches the Tettigoniidae than the Recent *Prophalangopsis* and the Jurassic genera.

Gryllidae. The Gryllidae exhibit a similar evolutionary stage to the Prophalangopsidae, but they show a deviating specialisation of the vesicula. The latter may be considered as a little more primitive than in Prophalangopsidae in so far as the trachea connecting the vesiculae of either side is wide and part of the vesicula itself. The "closing membrane," however, which was described in the paper referred to above, is a special acquisition of the Gryllidae and is not found in other families. This, again, agrees with the result of palaeontological investigation, that the Gryllidae must be derived from very primitive Prophalangopsids ancestral to both Gryllidae and Jurassic

Haglinae (Zeuner 1935). Prophalangopsidae and Gryllidae have the "double stigma" in common.

Tettigoniidae. In the Tettigoniidae two main groups of subfamilies may be distinguished according to the shape of the head. One group has a broad and rounded head with the vertex never prominent, though sometimes its fastigium may be armed with a spine. The antennae are inserted below the eyes. This primitive type of head is found in Gryllacrididae, Prophalangopsidae, Gryllidae, and certain Tettigoniidae. Among the latter it is restricted to the following subfamilies: Ephippigerinae, Pycnogastrinae, Deracanthinae, Bradyporinae, Hetrodinae, and Acridoxeninae.*

The other type of head is characterised by a more or less prominent vertex and often by a particular development of the fastigia frontis and verticis. The antennae are inserted between the eyes. This progressive type of head is found in all subfamilies not mentioned above. In a longitudinal section, the externally flat fastigia of *Decticus* prove to be separated by a deep infolding of chitin, and the fastigium verticis is almost entirely filled with muscles for the mouth-parts. Hence it is not unlikely that the enlargement of the vertex was initiated by an increase in strength of the gnawing muscles. Spine-like and other formations of the fastigium are secondary additions.

These differences in the head are combined with others, especially in the structure of the prothoracic tracheal apparatus. One is therefore entitled to consider those two groups of subfamilies as natural ones. They may be termed "Brachycephalia" (Ephippigerinae, etc.), and "Dolichocephalia" (Tettigoniinae, etc.), respectively, following a suggestion of Dr. Malcolm Burr. Apart from these two major groups, however, minor ones may be distinguished by the shape of the vesicula.

Bradyporoid group. All Tettigoniidae are distinguished from other long-horned Saltatoria by their separated truncal and femoral stigmata and the more highly specialised tracheae. The Bradyporinae, Ephippigerinae, Pycnogastrinae, Deracanthinae, and Hetrodinae, show only a slight advance in the structure of the tracheal apparatus as compared with *Cyphoderris*. The blind end of the vesicula is shorter, and the vesicula itself is curved downwards. There are always several tracheal main stems (though of different size) originating from the truncal stigma. The femoral stigma in these subfamilies is nearly always small, circular or oval. In addition to these common features are others in the structure of the head, pronotum, and elytra. One is therefore justified in segregating the five subfamilies under discussion from the remainder of the Tettigoniidae, as a distinct group which I call the "Bradyporoids." It is not yet possible to decide whether they should be promoted to the rank of a family although Tarbinsky has done so. The stigmata are of the Tettigoniid type as are the elytra. Head and tracheal apparatus, on the other hand, remind one of the Prophalangopsids.

Fortunately, a fossil form linking up the Bradyporoid group with the rest of Tettigoniidae, *Rammea laticeps*, is known from the Upper Miocene of Germany (Zeuner 1931). It is fully winged, equipped with a normal pronotum similar to that of a *Decticus*, but is brachycephalic as are the Bradyporoids.

I am further inclined to place here the genus *Acridoxena* hitherto included in the Mecopodinae. Caudell (1916) has already mentioned that the head of this peculiar form is reminiscent of Bradyporines and that it may be necessary to erect a separate subfamily for it. After an examination of both sexes of the

* The fossil Rammeinae also belong here, having a head of this type combined with a Tettigoniid pronotum. *Rammea* (Zeuner 1931) from the Upper Miocene is fully winged.

only known species I am in complete agreement with Caudell. The question is, however, whether the ACRIDOXENINAE have to be ranged with the Bradyporoids or whether they are an aberrant branch of the dolichocephalic TETTIGONIIDAE. The venation of the leaf-like fore-wings is too specialised to provide any argument. The upper margin of the mirror of the stridulating organ (right wing) is formed by the main stem of *Cu* and not, as in other TETTIGONIIDAE, by a parallel cross-vein. This may be interpreted as a primitive character directly derived from Prophalangopsids. As the evolution of the stridulating organ will be treated in detail in my catalogue of the Fossil Saltatoria I need not discuss here the special meaning of this difference. The hind-wings show no coalescence of *M*-branches with *Cu*, yet this may be due to a similar process of reduction as took place in the evolution of the Gryllacridid hind-wing. The pronotum of *Acridoxena* is spinose, and the spines are similarly arranged as in Recent HETRODINAE. The head is distinctly of the brachycephalic type. The antennae are inserted a little higher up than in most of the Bradyporoids, but their position is not quite constant in brachycephalic heads, Gryllacridids sometimes having the bases of the antennae almost between the eyes. The head of *Acridoxena* can thus be considered as primitive.

The structure of the tracheal apparatus of the prothorax is also primitive. The vesicula femoralis is of the kind found in *Uromenus* (EPHIPPIGERINAE). There are at least four truncal stems of which the first passes under the vesicula and becomes very large. The same has also been observed in HETRODINAE. The femoral stigma is also primitive and oval but almost circular. In these characters *Acridoxena* corresponds with certain Bradyporoids as well as with some primitive dolichocephalic Tettigoniids. This, in connection with the primitive head, points to the fact that *Acridoxena* is a member of the Bradyporoid group which shows some affinities to the higher groups.* I therefore place it, tentatively, with the former, of which it is the only Recent genus with wings developed.

Pseudophylloid group. A second very distinct group of subfamilies comprises the PSEUDOPHYLLINAE and a few others. I have studied the tracheae of only four species belonging here, but have looked at the stigmata of most of the genera. The stigmata are separated as in other TETTIGONIIDAE, but the femoral stigma is always very small, often hardly larger than the truncal one. The femoral stigma is of circular shape in all genera but a few where it is somewhat elongated or moon-shaped. The round, or almost round, femoral stigma is a character which the Pseudophylloids have in common with the Bradyporoids.

Another such character is the occurrence of several truncal main tracheae. I found four in *Pterophylla*, four in *Cymatomera*, two in *Cleandrus*, and one in *Acanthodis*, but this latter branches early. The shape of the vesicula femoralis confirms this arrangement of the genera to some extent. In *Pterophylla*, it forms a pointed knee, the point being the remainder of the blind end found in Bradyporoids and Prophalangopsids. The communicating trachea is present. In *Cymatomera* and *Acanthodis*, the vesicula resembles that of *Pterophylla*, although the point is missing. In its place, the vesicula with the upper portion of the femoral trachea forms a widened horn which is small as compared with the size of the thorax. It is more primitive in *Cymatomera* than in *Acanthodis*, and very similar to the type of *Uromenus* (Bradyporoids). In *Cleandrus* (and *Pseudophyllus*, *teste* Graber), a very peculiar " vesicula " is found. As described

* ACRIDOXENINAE and HETRODINAE have, as have all the higher TETTIGONIIDAE, stridulating organs in the male sex only.

in my earlier paper (1936) it is a very long and narrow tube of rather equal diameter. Such a form is derivable from the " horn " of *Cymatomera*; it is obviously a side-specialisation.

The groups under discussion also have certain features in the venation in common, and others of the head. The majority of their species imitate leaves or the bark of trees. One therefore may unite them in a group termed " Pseudophylloids," with the PTEROPHYLLINAE, PSEUDOPHYLLINAE (*Cymatomera*-group), PSEUDOPHYLLINAE *s.str.*, and the ACANTHODINAE which latter may be allied to, or be a side-branch of, the *Cymatomera*-group.

Tettigonioid group. The remaining TETTIGONIIDAE probably belong more closely together, perhaps with the exception of the somewhat isolated PHANEROPTERINAE. Therefore, it is not easy to separate the subfamilies, and groups of subfamilies, sharply, a fact known to every systematist. Yet it is possible to characterise at least two larger groups of subfamilies.

The first of them may be called the " Tettigonioid " group since it contains *Tettigonia* as the most typical genus. Not only the TETTIGONIINAE, but also the DECTICINAE, SAGINAE, MECOPODINAE, and PHYLLOPHORINAE, belong here. The TETTIGONIINAE and DECTICINAE are very closely allied. Uvarov (1924) considered them as even tribes of one and the same subfamily, merely distinguished by the absence, or presence, of free plantulae on the first hind tarsus. As the broad and rounded fastigium verticis which is typical of many Decticine genera, is not found without exception (some original genera like *Gampsocleis* having a rather narrow one) one has to admit that Uvarov's argument is conclusive. Where I still use the terms DECTICINAE and TETTIGONIINAE in this paper, it is because the relations of the other allied groups (particularly the SAGINAE) also need a thorough revision. Indeed, genera like *Terpandrus* and *Emptera* have, apart from other similarities, an elytral venation almost identical with that of TETTIGONIINAE.

The vesicula is " trumpet "-shaped in TETTIGONIINAE, DECTICINAE, and SAGINAE. The femoral stigma is very large, vertical and elongated. The inner wall of the vesicula is easily visible from the outside.

In *Mecopoda* (MECOPODINAE) the tracheal tract is similar to that of Tettigonoids, but the truncal main stem branches earlier than in TETTIGONIINAE, DECTICINAE, and SAGINAE. This appears to be a primitive feature since in another Mecopodine genus, *Sexava*, the common stem of the truncal tracheae is still shorter than in *Mecopoda*. Moreover, their trumpet-shaped femoral vesicula is comparatively small. In *Macrolyristes corporalis* Karny, a Mecopodine with an extraordinarily strong stridulating organ (the strongest of all Saltatoria ?), the vesicula is horn-shaped, similar to that of *Uromenus*, and small. Furthermore, there are at least three truncal tracheae with no common stem. In these respects, and also in the comparatively small femoral stigma, *Macrolyristes* is primitive. The truncal stems, however, are divided into innumerable branches filling the posterior portion of the prothorax. They evidently supply the air for the mesothoracic muscles used in stridulation. This is a specialisation which is very characteristic of the genus.

Thus, the MECOPODINAE exhibit very different evolutionary stages of the vesicula femoralis. *Macrolyristes* is comparable to primitive PSEUDOPHYLLINAE (*Cymatomera*) in its horn-shaped, small vesicula and the truncal main stems. *Mecopoda*, on the other hand, is hardly less highly evolved than *Tettigonia*. The open tympanum of MECOPODINAE being also more primitive than that of TETTIGONIINAE the former seem to connect the latter with some unknown ancestral form, at least as far as the tracheal apparatus of the prothorax is

concerned. The venation of MECOPODINAE, however, is more highly specialised than that of TETTIGONIINAE. In any case, their close relationship to the TETTIGONIINAE appears to be almost certain.

Siliquophora grandis Bl., a Phyllophorine, has a comparatively very small Tettigoniine trumpet. A common truncal main stem is present which soon gives off an upper branch. The stigma is of the Tettigoniine type. All this agrees well with the observations made on MECOPODINAE which the PHYLLOPHORINAE resemble in many respects. They appear to be a side-branch of the former.

The MECONEMINAE have small, circular or oval femoral stigmata. In *Meconema varium* L., the vesicula is small and horn-shaped, and looks primitive, but a common truncal stem is present. Since many MECONEMINAE appear to be reduced in several characters, especially in the stridulating apparatus, it is impossible to decide whether the conditions observed are primitive or not. Because of their venation, the structure of thorax and head, and the sulcate tarsi, I connect them tentatively with the Tettigonioid group which thus comprises the ?MECONEMINAE, the MECOPODINAE, PHYLLOPHORINAE, TETTIGONIINAE, DECTICINAE, and SAGINAE.

Conocephaloid group. The SALOMONINAE including AGRAECIINAE, the COPIPHORINAE, CONOCEPHALINAE (=XIPHIDIINAE), and LISTROSCELINAE have always been considered as a fairly homogeneous group. Karny (1912) considered them as tribes of one subfamily CONOCEPHALINAE, a procedure which I feel will be justified after a general revision of the relations of the subfamilies of TETTIGONIIDAE has been carried out. The group is obviously closely akin to the Tettigonioids, the primitive venation in the fore-wings of both being identical. So far, however, it is impossible to say whether the Conocephaloids were derived from some primitive Tettigonioids or whether they both originated from a common ancestor.

An examination of the prothoracic tracheae shows that the Conocephaloids cannot be derived from modern TETTIGONIINAE, SAGINAE, or similar forms. All types of tracheal apparatus have been found in the Conocephaloids, primitive Bradyporoid ones as well as very specialised ones reminiscent of PHANEROPTERINAE.

Salomona has a small, horn-shaped vesicula and four truncal stems, in other words, it is primitive. In the Salomonine genus *Amblylakis*, the vesicula possesses even a blind end. The truncal tracheae, however, have a common stem. The Copiphorine *Bucrates* also has a blind end though the whole vesicula is rather trumpet-shaped. This blind end appears to be the oriment, or rudiment, of an additional " camera " of the vesicula, which is present in *Conocephalus* and *Homorocoryphus*. In *Hexacentrus* (LISTROSCELINAE), a trumpet is found similar to that of *Decticus*, the blind end, or camera, being entirely absent. In *Agraecia* (SALOMONINAE) the trumpet has a sharp bend indicating the place of the camera. *Conocephalus* (CONOCEPHALINAE), *Homorocoryphus* (COPIPHORINAE), and also *Tympanophora* (TYMPANOPHORINAE), have trumpets supplied with a camera. Common truncal main stems are apparently present in all the latter groups. There is no doubt that the Conocephaloids have a tendency to develop an additional " camera " of the vesicula, probably from the primitive blind end which was inherited from the Prophalangopsid ancestors. The TYMPANOPHORINAE which I intend to treat separately in the near future, are closely allied to the LISTROSCELINAE. The venation of the male fore-wing is the same in *Tympanophora* and *Hexacentrus*.

Phaneropteroid group. The PHANEROPTERINAE are a homogeneous group. They are easily separated from other Tettigoniids by the first and second tarsal

joints being not sulcate laterally, a character that does not occur in any other subfamily. Again, one finds that the prothoracic tracheal apparatus has become specialised independently of the other groups. Primitive types of vesiculae may be observed just as may highly specialised ones. In *Orphania denticauda* the vesicula is very primitive, having a blind end and being reminiscent of the Bradyporoids. However, a common truncal stem is developed. Such common stem seems to be present in all PHANEROPTERINAE, but the truncal tracheal tract is, as a rule, weaker than in other TETTIGONIIDAE. In *Stilpnochlora* the femoral stigma is large and high, and hidden under the pronotum. In this genus as well as in *Eurycorypha* and *Zeuneria*, the whole femoral apparatus is directed forward, attached to the side-lobes of the pronotum, and not free as in the other subfamilies and in *Orphania*. In *Stilpnochlora* the vesicula is a simple trumpet; in *Eurycorypha* a very small additional camera is present; in *Zeuneria* a very large one is found, so large that the camerae of either side meet in the middle of the thorax and are pressed flatly against each other.

Thus, the PHANEROPTERINAE show all stages of specialisation in the femoral tracheal apparatus from the primitive Bradyporoid stage up to the final trumpet stage with a camera. Since the Phaneropteroid camera is somewhat different from that of the Conocephaloids, it is very likely that the PHANEROPTERINAE represent a lineage which is fairly independent of the other TETTIGONIIDAE.

New arrangement of subfamilies. The preliminary studies here recorded already offer the basis for a revision of the classification of Tettigoniid subfamilies. The studies can certainly be extended considerably and applied also to GRYLLIDAE. The ontogenetic evolution of the vesicula, for instance, which could be studied without difficulty, would probably reveal further details bearing on the relations of the genera and subfamilies.

It is, of course, impossible to construct a perfect phylogenetic system of Recent forms, since they are all of the same geological age, and have undergone varied specialisations but have occasionally retained primitive characters. "Spezialisationskreuzungen" or—as Crampton terms it—"heterospecialisations" are abundant in TETTIGONIIDAE. Most of the characters used in the systematics, such as spines, external appearance of the tibial tympanum, etc., are of little phylogenetic value. The terminal spurs of the hind tibiae, for instance, may easily become reduced and then replaced by some other spines moving down to the apex of the tibia. The form of the head, and the specialisation of the tracheal apparatus appear to be more reliable characters in the groups of genera here under consideration.

The resulting system is given below. I still consider it as preliminary, but I hope that it expresses affinities better than the earlier classifications given by Brunner, Kirby, and others, which all can be traced back more or less to the same original source. The ZAPROCHILINAE and PHASMODINAE, two small and highly aberrant subfamilies, are omitted.

Preliminary revised arrangement of the subfamilies of TETTIGONIIDAE.

Bradyporoids
- EPHIPPIGERINAE
- PYCNOGASTRINAE
- BRADYPORINAE
- DERACANTHINAE
- HETRODINAE
- ?ACRIDOXENINAE
- RAMMEINAE (extinct)

Pseudophylloids	Pterophyllinae Pseudophyllinae s. lat.
Tettigonioids	?Meconeminae Mecopodinae Phyllophorinae Tettigoniinae Decticinae Saginae
Conocephaloids	Salomoninae Copiphorinae Conocephalinae Listroscelinae Tympanophorinae
Phaneropteroids	Phaneropterinae

I herewith submit this system for the criticism of Orthopterists.

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NEW SPECIES OF *TIPULA* FROM THE PYRENEES AND MADEIRA (DIPTERA, TIPULIDAE)

By the late Dr. P. Lackschewitz.

(*Liepaja, Latvia.*)

Communicated by Dr. F. W. Edwards, F.R.E.S.

The two new species described below were included in a small collection made by Dr. F. W. Edwards in the Central Pyrenees in September 1935, and submitted to me for determination. The collection also included specimens of *T. breviantennata* Lacksch. and *T. subsignata* Lacksch., two species which I have recently described from the Apennine mountains.

All these species belong to the same group, which I would suggest calling the *obsoleta* group. The species of this group are all very similar, and have many points of agreement in the structure of the hypopygium, though they exhibit characteristic differences in the structure of the 8th sternite, the 9th tergite and the *appendices intermediae*. In addition to the two new species and the two mentioned above the following European species belong to this group : *T. marmorata* Mg., *obsoleta* Mg., *alpium* Bergr., *vafra* Ried., *staegeri* Niels., *signata* Staeg., *cheethami* Edw., *rufina* Mg., *invenusta* Ried., *gimmerthali* Lacksch. and (in spite of its unspotted wings) *pagana* Mg.

I have stated my position in regard to the species-concept in my paper on *Tipula oleracea* (1930).* It may be that in some cases, as for example in *T. vafra* Ried. and *T. subvafra* sp. n., we are dealing with geographical varieties in the sense of Wagner and Jordan, and that the distinction will prove inconstant when we obtain sufficient material, especially from the Alps and from Central Europe.

Tipula serrulata sp. n.

Head grey. Rostrum brownish. Palpi dark brown. Antennae of ♂ as long as head and thorax together, scape yellow, flagellum dark brown, verticils short. *Thorax* grey, praescutum with four dark brown stripes, scutum with obliquely placed dark brown marks, postnotum with dark brown median line; pleurae whitish-grey dusted. *Abdomen* yellowish, with dark lateral stripes, terminal segments brown; hypopygium swollen. *Legs*: coxae yellowish, grey-dusted; femora and tibiae yellowish with blackish-brown tips; tarsi blackish brown; spurs 1.2.2. *Wings* with a light grey tinge, with black veins, blackish-grey stigma, and light spots on the membrane; the most distinct of these spots are in the middle of the lower basal cell and in the anal cell; a whitish mark before the stigma. Halteres whitish-grey with dark knob. Wing-length 13 mm.

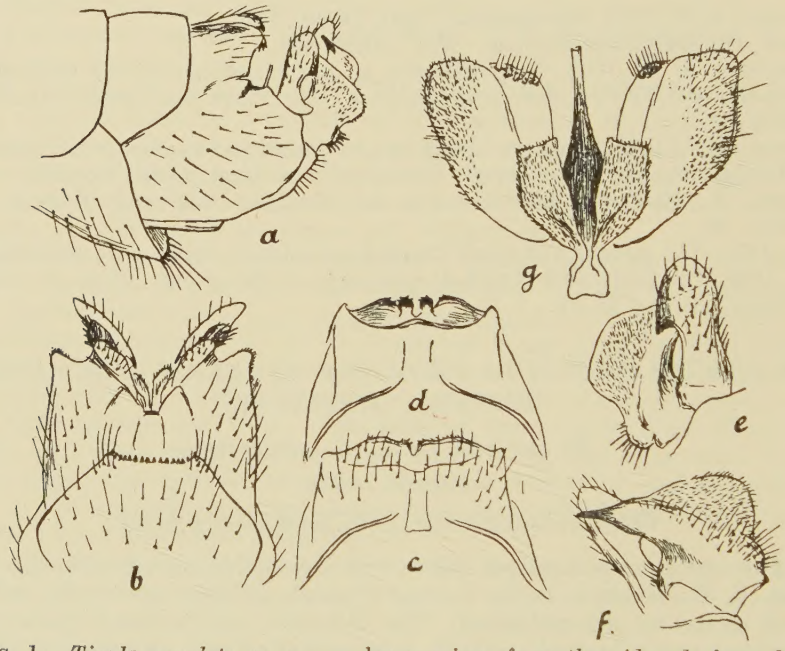

Fig. 1.—*Tipula serrulata* sp. n.; *a*, hypopygium from the side; *b*, from below; *c*, *lam. term. sup.* (9th tergite) from above; *d*, from inside; *e*, left *appendix supera* and *intermedia* from outside; *f*, from inside; *g*, adminiculum.

This species stands near *T. obsoleta* Mg., but the hypopygium shows obvious distinctions in all its parts. The eighth sternite is broadly truncate and bears on its hinder border a row of sharp black teeth. In the middle of the ninth tergite is a small indentation which on the underside is flanked by a pair of knob-like processes, these latter having some fine sharp teeth at their tips. The *appendices superae* have a hook-like process on their front margin. The

* 1930, Lackschewitz, P., *Konowia*, **9** : 257–278.

appendices intermediae resemble those of *T. vafra* Ried., but terminate in an undivided black point.

ANDORRA : Port de Siguer, *c.* 7000 ft., ix.1935, 1 ♂, type (*F. W. Edwards*).
ENGLAND : Wyre Forest, 4.ix.1892, 1 ♂ (*G. H. Verrall*); in coll. J. E. Collin.

Tipula subvafra sp. n.

Head including rostrum grey. Palpi dark brown. Antennae of ♂ longer than head and thorax together, scape yellow, flagellar segments cylindrical, verticils half as long as segments. *Thorax* grey, praescutum with four dark brown stripes. *Abdomen* yellowish-brown, with a dark stripe on each side, the two segments before the swollen hypopygium brown. *Legs* : coxae yellowish, femora and tibiae greyish-brown with darker tips, tarsi dark brown; spurs 1.2.2. *Wings* with a light grey tinge, with black veins, blackish-brown stigma and pale spots on the membrane, of which the most distinct are a spot in the middle of the lower basal cell and another in the anal cell, and a pale mark before the stigma. Halteres whitish-grey with dark brown knob. Wing-length 12 mm.

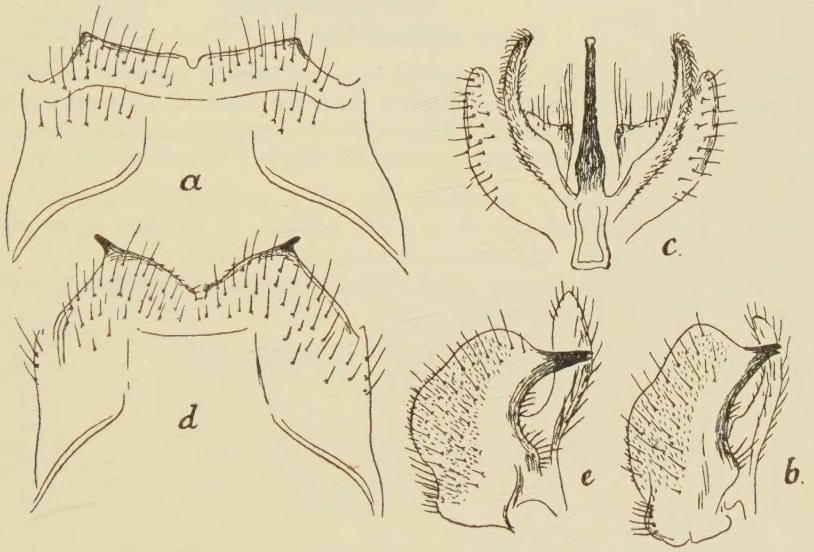

FIG. 2*a–c*.—*Tipula subvafra* sp. n.; *a*, ninth tergite; *b*, left *appendix supera* and *intermedia* from inside; *c*, adminiculum; 2*d–e*—*T. vafra* Riedel, *d*, ninth tergite; *e*, left *appendix supera* and *intermedia* from inside.

The hypopygium bears a close resemblance to that of *T. vafra*, to which species *T. subvafra* is very closely related. A specific difference occurs in the ninth tergite : whereas in *T. vafra* this has the corners produced in a characteristic manner into small black points, in *T. subvafra* the corners are bluntly rectangular. The *appendix intermedia* terminates a short black beak which is bifid at the tip. The *appendices superae* are narrower, and the adminiculum also shows small differences, the black median process or penis-sheath being distinctly longer and more slender than in *T. vafra*.

FRANCE : Arriège, Siguer gorge, 3000 ft., ix.1935, 1 ♂ (*F. W. Edwards*).

The two forms described below from the Wollaston collection from Madeira are striking forms of known European species; or at any rate the hypopygia agree with those of already known species. One male I can only regard as a

variety of *T. rufina* Mg., in spite of the lack of the dark pleural stripe, because the hypopygium is exactly as in that species; I have seen typical *T. rufina* from the Canary Is. in the Helsingfors Museum, and I believe that *T. multipicta* Becker is this species. The second Madeiran species described here is a very striking dark form of *T. mediterranea* Lacksch.; in this case it may be better to regard the Madeiran form as a distinct species, as there are differences (even though very small ones) in hypopygial structure.

Tipula rufina Meig. var. **maderensis** var. n.

Differs from typical *T. rufina* in its size (wing-length 16 mm.; in *T. rufina* it is usually 13–14 mm. in the ♂, and even in the ♀ seldom reaches 16 mm.); in the complete absence of the dark longitudinal stripe on the pleurae; also in the banded abdomen, the dark lateral spots on the tergites extending upwards and leaving only a narrow pale dorsal stripe on the first three segments; hind margins of tergites broadly yellow.

Madeira: 1 ♂ in Brit. Mus. (*T. V. Wollaston*), 1855.

Tipula wollastoni sp. n.

General colour dark brown. Head brown, including clypeus; genae yellowish. Antennal flagellum yellowish-brown, the slightly thickened bases of the segments black. Thorax, abdomen and legs dark brown. Wings with a deep brown tinge, with darker stigma and dark costal margin, but without pale streak in the middle. Wing-length 19 mm.

The hypopygium closely resembles that of *T. mediterranea* Lacksch., but the bristles on the front margin of p. 2 are lacking; p. 3 bears short bristles on its lower margin, and p. 1 is shorter, stouter and less bent.

A similarly coloured ♀ has reduced wings, 12·5 mm. in length, which reach only to the middle of the abdomen.

Madeira: 1 ♂, 1 ♀, in Brit. Mus. (*T. V. Wollaston*), 1855.

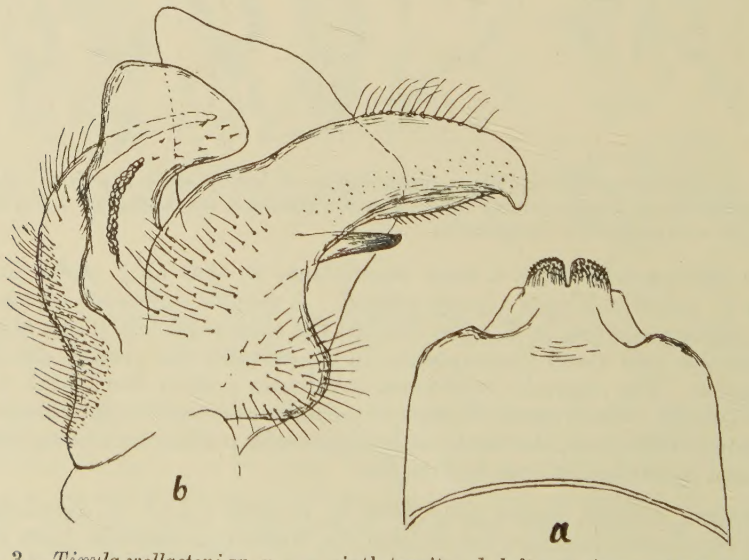

Fig. 3.—*Tipula wollastoni* sp. n.; *a*, ninth tergite; *b*, left *app. interm.* from inside.